Title: How Does Your Garden Grow?

Brief Overview:

Students will use a variety of activities, projects, and games to practice using arrays and to develop fluency for targeted multiplication facts. Students will focus on the 21 hard-to-learn facts as they work as garden engineers, helping Farmer Magill solve a variety of problems he is having with his garden.

NCTM Content Standard:

Develop fluency in multiplying whole numbers.

Grade/Level:

Grades 3-5

Duration/Length:

Three 60-minute sessions

Student Outcomes:

Students will:

- Create pictorial arrays for target multiplication facts.
- Increase math fact fluency for the target multiplication facts.
- Solve multiplication story problems and explain their thinking using words, pictures, and/or numbers.

Materials and Resources:

DAY 1

- Student resource- "Pre-assessment"
- Teacher resource- "Pre-assessment answer key"
- Teacher resource- Multiplication Table transparency
- Student resource- Farmer Magill's letter about a scarecrow
- 1 large sheet of paper per table group for brainstorming
- Teacher resource- Vocabulary Word Cards
- Teacher resource- Scarecrow Image
- Student resource- Scarecrow Patch
- Student resource- "Where's the Carrot?" Directions
- Student resource- "Capture the Rabbit" directions
- Student resource- "Where's the Carrot?"/"Capture the Rabbit" cards
- Student resource- "Patch It Up"

- 1 large sheet of chart paper to chart class ideas
- 1 large outline drawing of a scarecrow on a poster or chart paper
- Crayons, scissors, tape or glue

DAY 2

- Student resource- Farmer Magill's letter about mapping out the garden
- Student resource- Plant Cut Outs
- Student resource- "Beat the Bunny" directions
- Student resource- "Beat the Bunny" game board
- Student resource- "Beat the Bunny" cards
- Student resource- "Beat the Bunny" answer sheet
- Student resource- "Beat the Bunny" markers
- Green 12"x24" construction paper
- Student resource- "Bunny Bingo"
- Student resource- "Bunny Bingo" markers
- Glue and scissors

DAY 3

- Student resource- Farmer Magill's thank you letter
- Student resource- "Oh no!" pumpkin problem
- Student resource- "Capture the Rabbit" directions
- Student resource- "Where's the Carrot?"/"Capture the Rabbit" cards
- Student resource- "Beat the Bunny" cards
- Student resource- "Beat the Bunny" answer sheet
- Student resource- "Bunny Bingo"
- Student resource- "Bunny Bingo" markers
- Student resource- "Summative Assessment"
- Teacher resource- "Summative Assessment answer key"
- 2 whiteboards and markers

Development/Procedures:

Day 1

Pre-assessment

- Distribute a copy of student resource, "Pre-assessment." Allow two minutes for the students to complete these basic facts.
- Check answers with students referring to teacher resource, "Pre-assessment Answer Key." Students circle any incorrect answers with a green crayon.
- Using a transparency of teacher resource, multiplication table, the teacher demonstrates the area of the chart that has more challenging facts to learn.
    - "Let's locate the more difficult facts to learn on this multiplication table. First we can draw a line through the easy 1s, 10s, 5s, and 2s. Demonstrate this on the transparency.
    - Squares like 3x3 and 6x6 can be easy to remember, so let's eliminate those. Place an X on 9, 16, 36, 49, 64, and 81.

- Using the commutative property of multiplication, $a \times b = b \times a$, we can also cross out the partner facts. For example, we don't need to have 3x4 as well as 4 x3. We can eliminate any partner facts that are left.
- Now if we look at the facts that are still uncovered on the table, we see that there are only twenty-one facts on which we need to focus. We can call these our target facts. Let's take on the Farmer's Challenge and master these facts over the next few days.

Engagement

- Distribute student resource, Farmer Magill's letter about the scarecrow.
- Read aloud the letter from Farmer Magill, who needs help with his garden.

Exploration

- In pairs or table groups, students brainstorm how multiplication can help Farmer Magill. Each group records their ideas on a large sheet of blank paper.
- Have student groups share ideas with the class.
- Record student suggestions on chart paper.
    - Answers will vary. They may include, for example, how many plants to put in equal rows, how many plots of different vegetables the farmer may want, how to group his cows into pastures, etc.

Explanation

- Refer to the teacher resource, vocabulary word cards (factor, array, product, and multiplication). Display and explain each of the four vocabulary word cards for the class.
- Model the concept of linking number facts to pictorial arrays
    - Explain and model 3 x 4. The first factor (3) indicates the number of groups or horizontal rows. The second factor (4) indicates the number in each group or vertical columns.
    - Draw carrots to represent the array 3x4.
- Refer to teacher resource, Scarecrow Image. Display a large scarecrow on a classroom bulletin board or wall. This can be a large outline of a scarecrow on a poster or chart paper.
- Refer to student resource, Scarecrow Patch. Model drawing an array on it and writing a corresponding multiplication sentence. Color the patch and tape it to the scarecrow on display.

Application

- Distribute student resource, Scarecrow Patch. Students will select a multiplication fact from the targeted set (use the pre-assessment as a guide for choosing a fact) and write it on the patch. Draw a corresponding array. Students should color their patches so they are more helpful in scaring away the crows.
- Each student should share the multiplication fact they illustrated and tape his/her completed patch to the scarecrow.

Differentiation

Reteach
Lead a small group in completing the patch activity. Review the concept of matching multiplication facts to corresponding arrays.
Enrich
Bring the enrichment group to the carpet. Refer to student resources, "Where's the Carrot?" and "Where's the Carrot?"/"Capture the Rabbit" cards. Quickly model how to play. Have students choose a partner to play the game.
For an advanced variation to "Where's the Carrot?" refer to student resource, "Capture the Rabbit" directions.

Assessment

- Distribute student resource, "Patch It Up." Tell students that they will be explaining what they learned about arrays and the target facts to complete the exit card, "Patch It Up".

Day 2

Engagement

- Distribute student resource, the second letter from Farmer Magill (letter about mapping out the garden).
- Read aloud the letter from Farmer Magill that encourages the students to organize his garden by applying their knowledge of the target facts.

Exploration

- Ask students to brainstorm ideas for how they could help Farmer Magill with his garden.
- Have students share ideas with a partner or table group
- Ask each pair or table to share one idea with the class.

Explanation

- Referring to student resource, Farmer Magill's letter about mapping out the garden, model for the students how to begin plotting Farmer Magill's garden.
- The students will highlight these sentences in their letter. "I have six plots to plant strawberries, tomatoes, watermelons, lettuce, corn, and onions. I need to plant everything in neat rows. Each plot needs a different number of rows and the same number of plants in each row. I need to have sections of my garden with 3, 4, 5, 6, 7, and 8 rows. Please create a map for me so I will know where to plant my fruits and vegetables.
- Given a piece of green construction paper (12" x 24"), the students will design where to plant each crop and how much to plant of each crop. They may work with partners or in table groups.
- Students can choose from the target facts (see pre-assessment) to plan their garden plots. For example, the section that has 3 rows might be corn with the target fact 3 x 7 = 21. Students cut out 21 ears of corn and glue them to a section of the construction paper.

- Refer to student resource, Plant Cut Outs. Distribute the plant cut outs, one per pair or group. Students will need to cut out the plants and glue them in their gardens.
- Label each section with the corresponding multiplication fact. Draw a fence around each garden plot to separate them from each other and move on to the next plot.
- Students will work with a partner or in small groups to design and create a garden for Farmer Magill. They will need to create a 6-plot garden with a plot that has rows corresponding with each number 3-8.
- Students can compare their completed garden projects with others when all are finished.

Application

- Refer to student resources, "Beat the Bunny." Distribute all of the materials needed to play "Beat the Bunny." Students will need one set of materials for every two students.
- Partners work together to play the "Beat the Bunny" board game practicing the target facts.

Differentiation

Reteach
Facilitate a small group that needs additional direction or assistance planning and creating their garden project.
Enrich
After completing the "Beat the Bunny" game, partners can use the game cards as flashcards to practice accuracy and fluency of the target facts.

Assessment

- Refer to the student resources, "Bunny Bingo." Distribute all of the materials for "Bunny Bingo." Tell students to cut out the bingo game pieces and insert products in their game cards. Review game directions with the students before beginning the game.
- The teacher can use the cards from "Beat the Bunny" in order to call the bingo game. The teacher draws a card, states the target fact, and students will place a marker on the product if it is on their bingo board.
- You may want to provide "Bunny Bingo" winners with a sticker, pencil, or small prize to increase motivation.
- Observe as students play, noting how comfortable students are with the target facts.

Day 3
Engagement

- Distribute the last letter, student resource, thank you letter from Farmer Magill.
- Read aloud the letter from Farmer Magill in which he thanks the students for their help and encourages them to continue practicing their multiplication facts.

Exploration

- Refer to student resource, "Oh No!" pumpkin problem. Distribute "Oh No!" and have partners illustrate an array for a target fact and explain their thinking while solving a story problem.

Explanation

- Refer to student resources, "Beat the Bunny" cards and "Beat the Bunny" answer sheet. Tell the students that we have represented the target facts with arrays, using pictures and symbols to represent the factors for basic facts. This can be very helpful in figuring out the answer, but can take a long time. We want to be less dependent on this aid and become increasingly able to answer the target facts more fluently. Flashcard practice can help us increase our fluency and commit these facts to memory for quick recall.
- Model how to use flashcards with a partner. Player A shows a multiplication fact and player B provides the product. After the cards are all shown, the players trade roles. Students should respond with the complete number sentence when answering. Player A can look at student resource, "Beat the Bunny" answer sheet to make sure that player B is providing the correct answer.
- One variation would be to divide students into groups of three and they can take turns being a timekeeper. They can record their personal time going through the set of flashcards and then try to beat their own time on subsequent turns. Students should aim to be able to answer each fact in 5 seconds or less.

Application

- Partners quiz each other using the flashcards from "Beat the Bunny" game to increase fluency and focus on mastery of the target facts.
- Refer to student resources, "Capture the Rabbit" and "Where's the Carrot?"/"Capture the Rabbit" cards. Partners can review the target facts by playing the "Capture the Rabbit" memory game to link factors with their products.

Differentiation

Reteach

Lead a small group in "Capture the Rabbit" or the "Bunny Bingo" game.

Enrich

Partners use "Capture the Rabbit" flashcards to review target facts together.

Table groups play "Bunny Bingo" with a selected student calling out the multiplication facts. The winner of the game becomes the caller for the next game.

Assessment

- Students will be divided into two teams. Teams line up one behind the other facing forward. At the beginning of each line will be a student desk with a whiteboard and marker on it. The teacher calls out a multiplication fact and a student from each team writes the product on the small whiteboard. The first player who writes the correct product on their board earns a point for their team. Repeat this process with the next player from each team. The team with the most points at the end of the game wins.

Summative Assessment:

The students will use target facts to solve three story problems and support their answers as BCRs. The students will have 2 minutes to complete a post-assessment that will measure their mastery of the target facts in a designated time period.

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Name_____

Pre Assessment

Answer as many facts as you can in 2 minutes.

3x4=	4x9=	3x9=
4x6=	5x8=	5x6=
3x6=	3x5=	6x8=
4x7=	4x8=	7x8=
3x8=	6x7=	3x7=
5x7=	8x9=	7x9=
4x5=	5x9=	6x9=

Name_____

Pre Assessment- Answer Key

Answer as many facts as you can in 2 minutes.

3x4=12	4x9=36	3x9=27
4x6=24	5x8=40	5x6=30
3x6=18	3x5=15	6x8=48
4x7=28	4x8=32	7x8=56
3x8=24	6x7=42	3x7=21
5x7=35	8x9=72	7x9=63
4x5=20	5x9=45	6x9=54

Multiplication Table

X	1	2	3	4	5	6	7	8	9	10
1	1	2	3	4	5	6	7	8	9	10
2	2	4	6	8	10	12	14	16	18	20
3	3	6	9	12	15	18	21	24	27	30
4	4	8	12	16	20	24	28	32	36	40
5	5	10	15	20	25	30	35	40	45	50
6	6	12	18	24	30	36	42	48	54	60
7	7	14	21	28	35	42	49	56	63	70
8	8	16	24	32	40	48	56	64	72	80
9	9	18	27	36	45	54	63	72	81	90
10	10	20	30	40	50	60	70	80	90	100

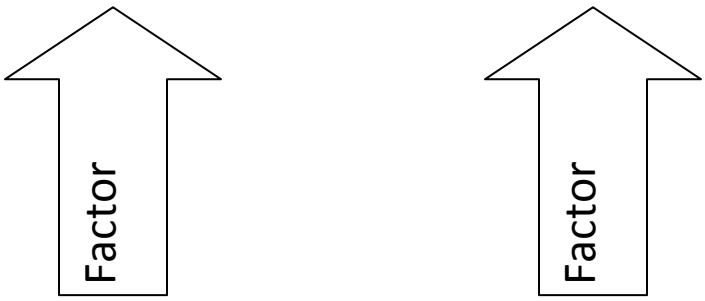
Dear Garden Engineer,

I am so glad that you have offered to help me create the best garden possible. I have been having a lot of trouble lately with the crows trying to steal my vegetables. They are feasting in my garden and I cannot get them to leave my garden alone! I need your help creating a scarecrow that will keep the crows away. He needs to have a lot of patches with bright colors and different shapes arranged in arrays on his overalls to scare off the crows. Please help me make the patches so my vegetables will be safe! Thank you so much for your help, I could not do it without you!

Sincerely,
Farmer Magill

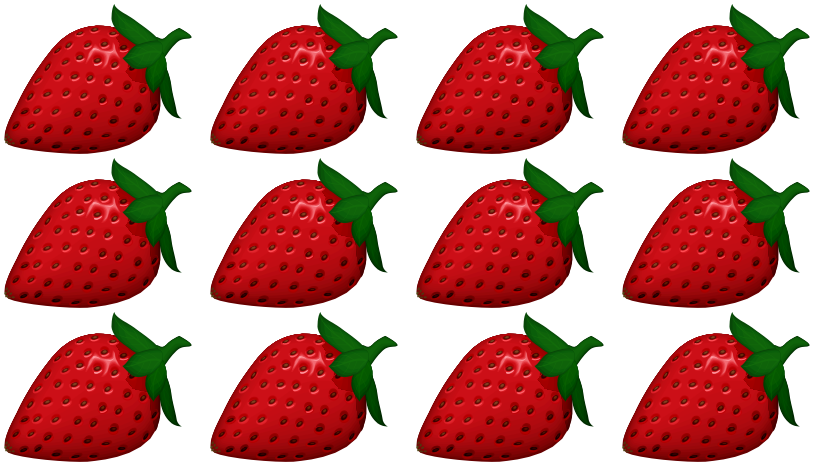
factors

6x8=



Factors are the numbers that can be multiplied to create a bigger number.

array



$$3 \times 4 = 12$$

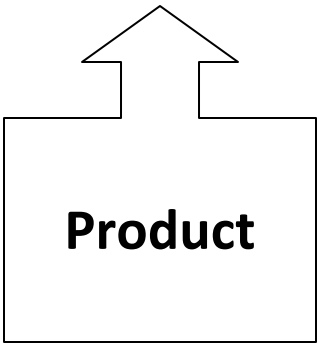
The number of rows

The number of columns

An array can be created to illustrate factors in a multiplication problem. The number of rows and columns are the factors in the array.

product

8x9=72



The product is the answer for a multiplication problem. When you multiply the factors, you get the product.

multiplication

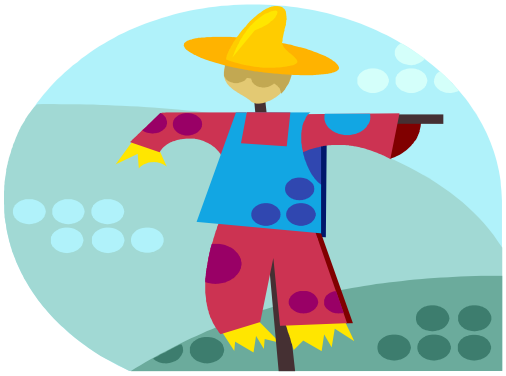
Multiplication is the process used to find the product of 2 numbers. The inverse operation for multiplication is division.

Scarecrow Image
Teacher can use this as a guide when drawing a larger version for students to place their patches.

Scarecrow Patch

Use bright colors and shapes to create an array that represents a multiplication fact on your patch. Cut it out and put it on the scarecrow to ward off the crows! Be sure to write your fact on the bottom of your patch.

My fact is_____

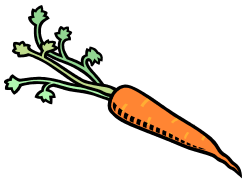


Where's the Carrot?

Players: 2
Materials: Cards with facts and arrays
How to play:

1. Cut fact cards and array cards apart and place them all face down on the table or floor.
2. Player 1 flips over 2 cards. If the array matches the math fact, player one takes the match and tries again. If the cards are not a match, return the cards to their original position face down.
3. Player 2 flips over 2 cards. If the array matches the math fact, player one takes the match and tries again. If the cards are not a match, return the cards to their original position face down.
4. Once all cards have been flipped and collected, both players count the number of matches they collected.
5. The player with the most matches wins.
6. Have fun!

Where's the Carrot?



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Capture the Rabbit

Players: 2
Materials: Cards with facts and products
How to play:

1. Cut fact cards and product cards apart and place them all face down on the table or floor.
2. Player 1 flips over 2 cards. If the product matches the math fact, player one takes the match and tries again. If the cards are not a match, return the cards to their original position face down.
3. Player 2 flips over 2 cards. If the product matches the math fact, player two takes the match and tries again. If the cards are not a match, return the cards to their original position face down.
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"Where's the Carrot?"/"Capture the Rabbit" cards

 3x4=	 4x9=	 3x9=
 4x6=	 5x8=	 5x6=
 3x6=	 3x5=	 6x8=

4x7=

4x8=

7x8=

3x8=

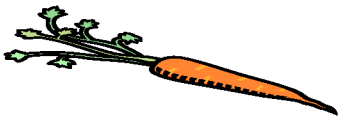
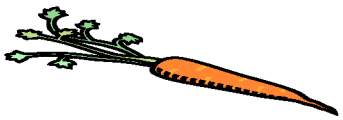
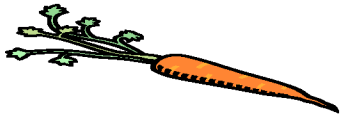
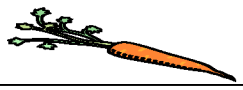
6x7=

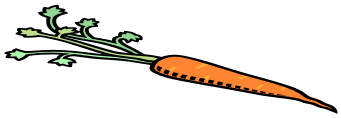
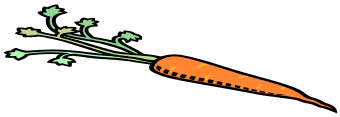
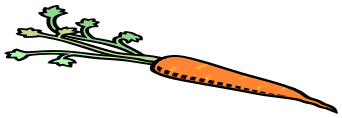
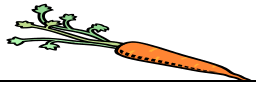
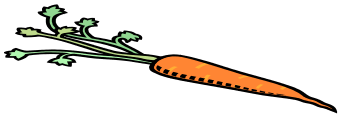
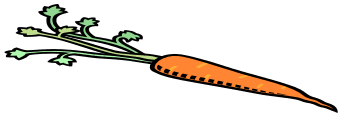
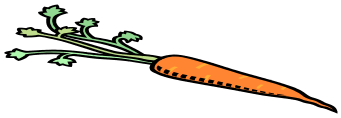
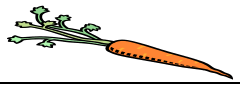
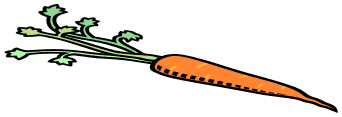
3x7=

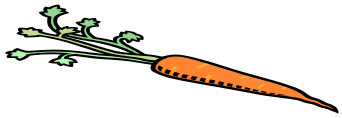
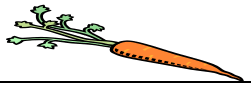
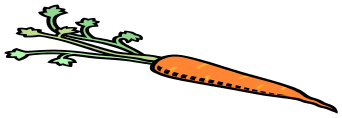
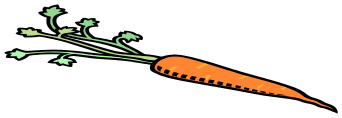
5x7=

8x9=

7x9=

 4x5=	 5x9=	 6x9=
XXX XXX XXX XXX 	XXX XXX XXX XXX XXX 	XXX XXX XXX XXX XXX XXX 
XXX XXX XXX XXX XXX XXX XXX 	XXX XXX XXX XXX XXX XXX XXX 	XXX XXX XXX XXX XXX XXX XXX 

XXXX XXXX XXXX XXXX XXXX 	XXXX XXXX XXXX XXXX XXXX XXXX 	XXXX XXXX XXXX XXXX XXXX XXXX XXXX 
XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX 	XXXXX XXXXX XXXXX XXXXX XXXXX XXXXX 	XXXXX XXXXX XXXXX XXXXX XXXXX XXXXX XXXXX 
XXXXX XXXXX XXXXX XXXXX XXXXX XXXXX XXXXX XXXXX 	XXXXX XXXXX XXXXX XXXXX XXXXX XXXXX XXXXX XXXXX 	XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX 

XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX 	XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX 	XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX 
XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX 	XXXXXXXXX XXXXXXXXX XXXXXXXXX XXXXXXXXX XXXXXXXXX XXXXXXXXX XXXXXXXXX XXXXXXXXX XXXXXXXXX 	XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX 
 12	 36	 27

 24	 40	 30
 18	 15	 48
 28	 32	 56

 24	 42	 21
 35	 72	 63
 20	 45	 54

Name_____

"Patch It Up"

What was the multiplication problem you illustrated on your patch?

_____

Use words, numbers, pictures, and/or symbols to explain how you solved the problem.

Name_____

"Patch it up"

What was the multiplication problem you illustrated on your patch?

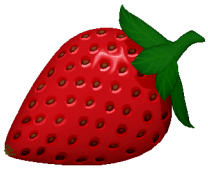
_____

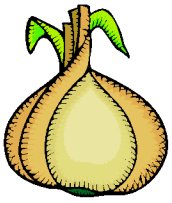
Use words, numbers, pictures, and/or symbols to explain how you solved the problem.

Dear Garden Engineer,

Thank you so much for your help yesterday. I put the scarecrow in my garden and the crows are finally staying away. Great work!

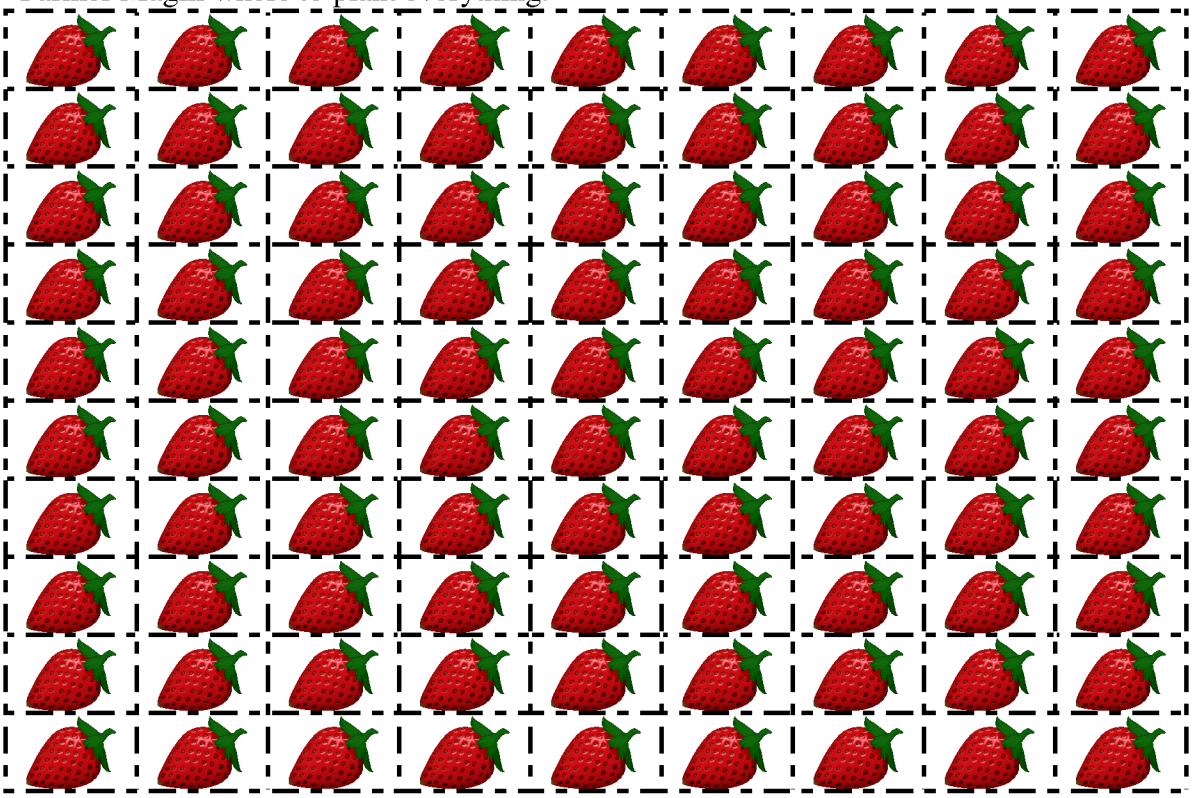
Now I am in need of more help. My garden is a mess and I don't know which crops are which. Please help me map out where I should plant everything. I have six plots to plant strawberries, tomatoes, watermelons, lettuce, corn, and onions. I need to plant everything in neat rows. Each plot needs a different number of rows and the same number of plants in each row. I need to have sections of my garden with 3, 4, 5, 6, 7, and 8 rows. Please create a map for me so I will know where to plant my fruits and vegetables. Thank you so much for your help. I can't wait to get my garden organized!

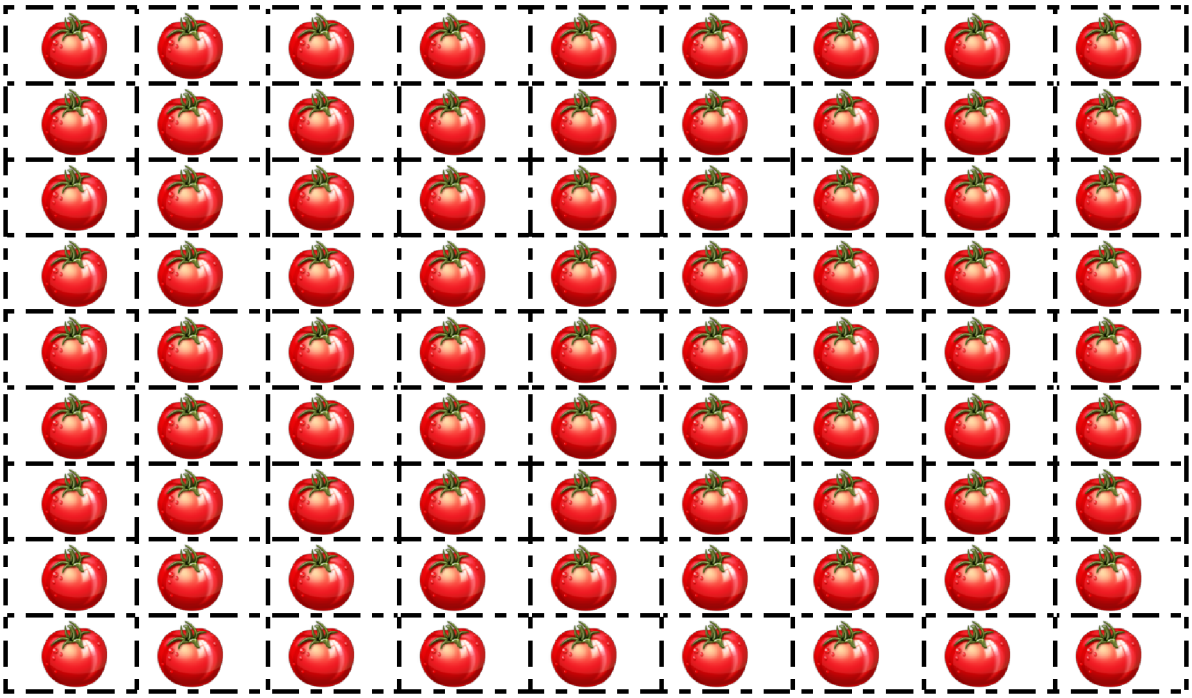


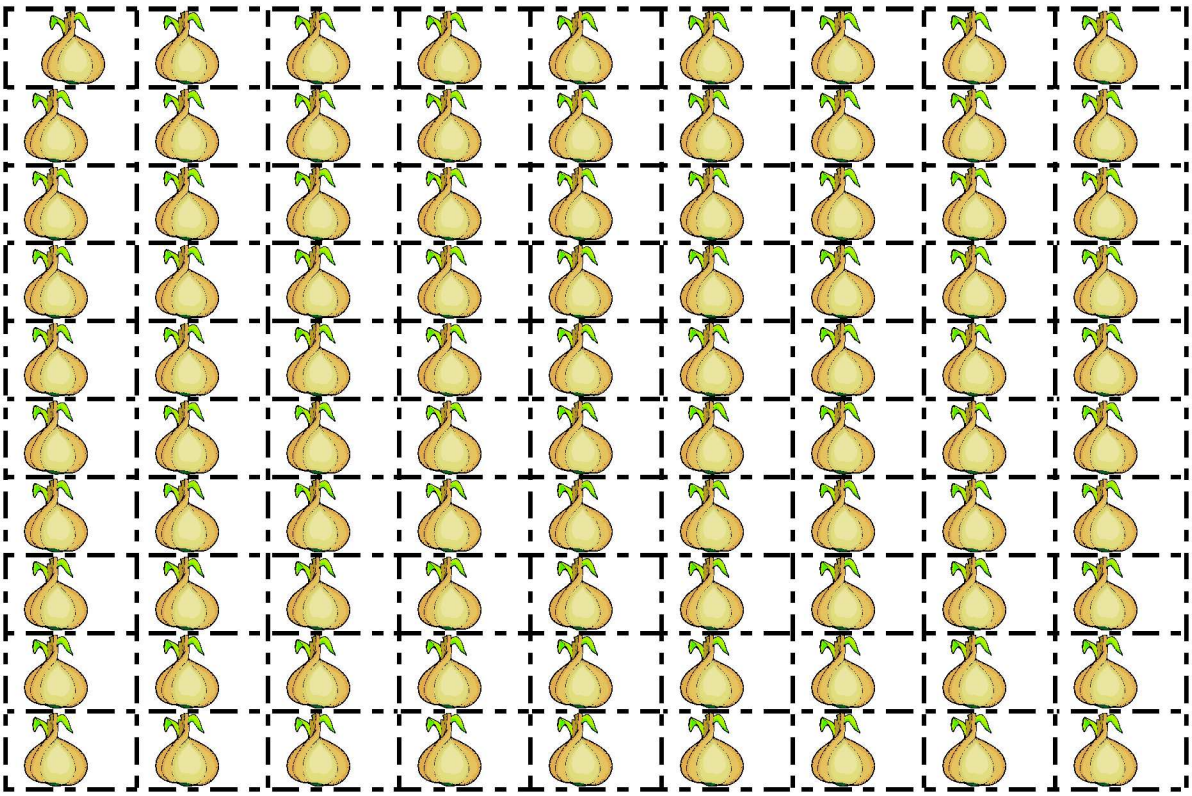


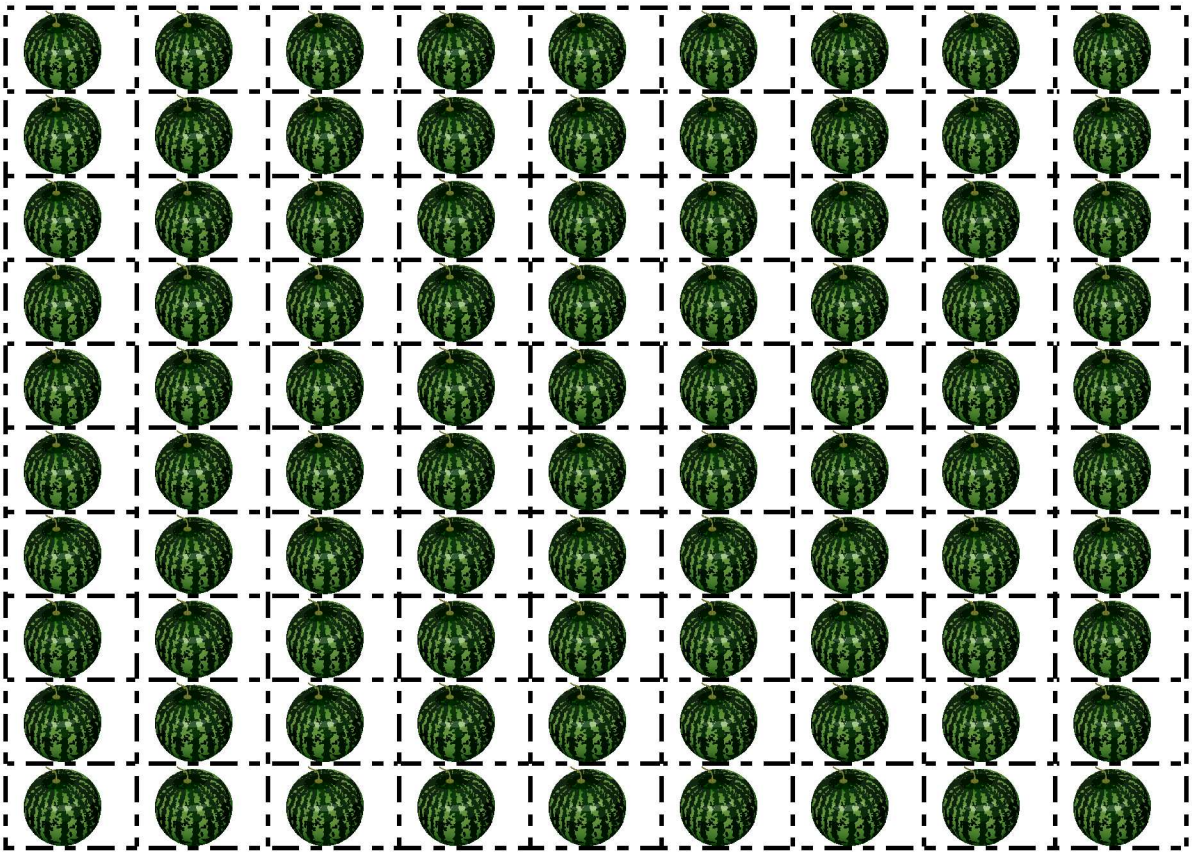

Sincerely,
Farmer Magill

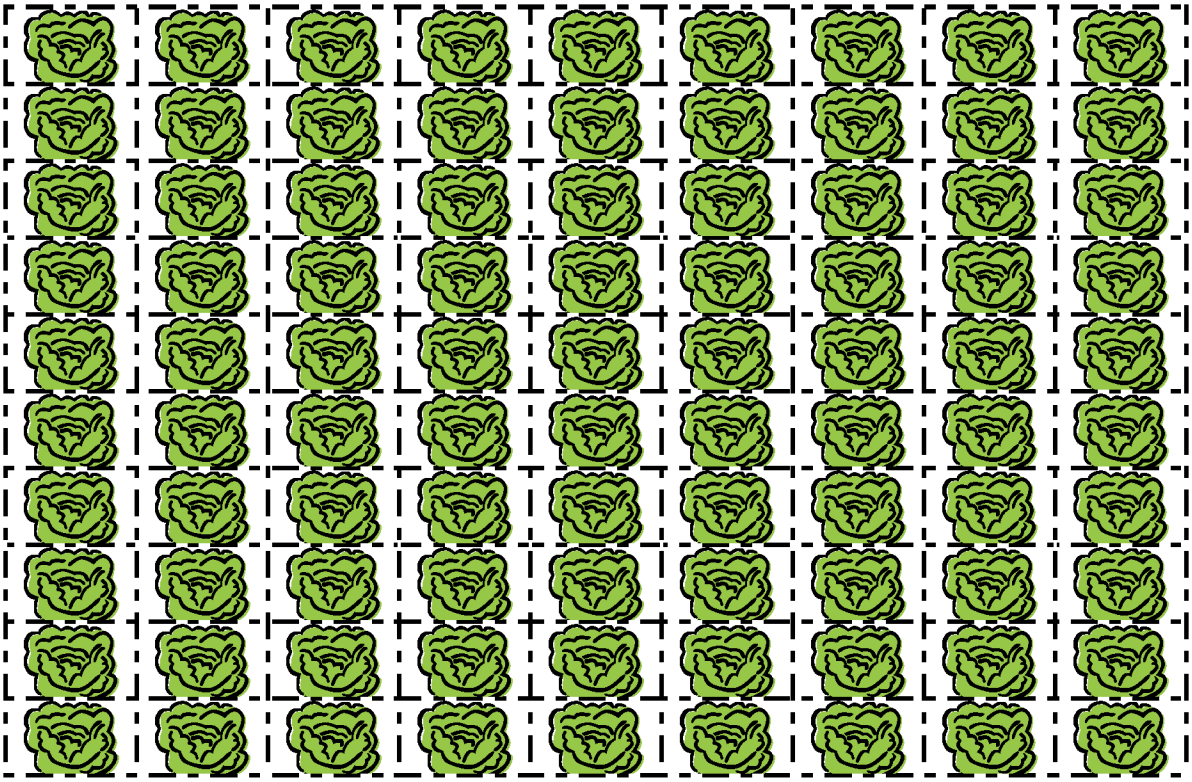
Plant Cut Outs- Cut out the pictures and glue them in rows in your garden to show Farmer Magill where to plant everything.

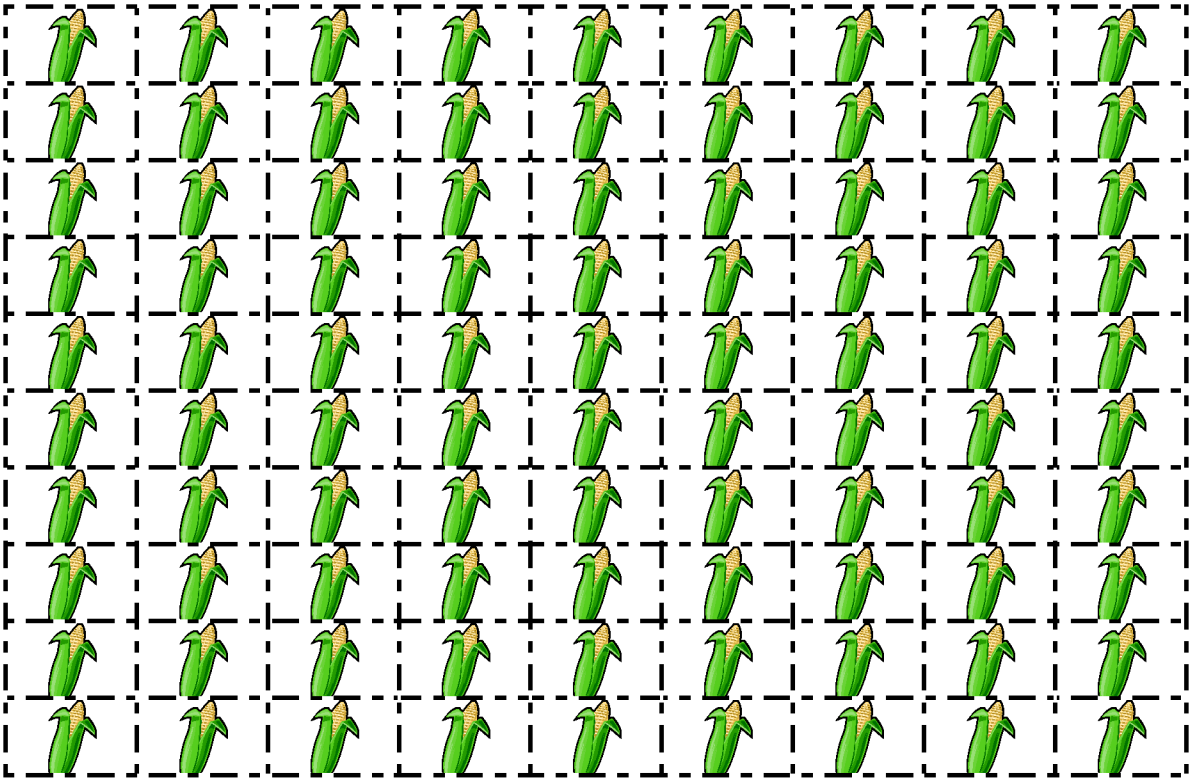












Beat the Bunny

Players: 2
Materials: Beat the bunny game board, cards, 2 place markers, and answer key
How to play:

1. Cut bunny cards apart and place them face down in a pile on the game board.
2. Place your markers on the "start" spot.
3. Player 1 draws a card. Player 2 looks at the answer sheet.
4. Player 1 answers the problem on the card within 5 seconds. (count 1 Mississippi, 2 Mississippi etc…)
5. Player 2 checks the answer card to see if Player 1's answer is correct.
6. If the answer is correct, move ahead 2 spaces. If the answer is incorrect, move back 1 space.
7. Switch. Continue playing until one player has beat the bunny!
8. Have fun!

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7. Switch. Continue playing until one player has beat the bunny!
8. Have fun!

START

Beat the Bunny

Place cards face down here

END

 3x4=	 4x9=	 3x9=
 4x6=	 5x8=	 5x6=
 3x6=	 3x5=	 6x8=

4x7=

4x8=

7x8=

3x8=

6x7=

3x7=

5x7=

8x9=

7x9=

		
4x5=	5x9=	6x9=

Beat the Bunny

Answer Sheet

3x4=12	4x5=20	5x6=30	6x7=42	7x8=56	8x9=72
3x5=15	4x6=24	5x7=35	6x8=48	7x9=63	
3x6=18	4x7=28	5x8=40	6x9=54		
3x7=21	4x8=32	5x9=45			
3x8=24	4x9=36				
3x9=27					

Beat the Bunny

Answer Sheet

3x4=12	4x5=20	5x6=30	6x7=42	7x8=56	8x9=72
3x5=15	4x6=24	5x7=35	6x8=48	7x9=63	
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3x8=24	4x9=36				
3x9=27					

“Beat the bunny” game place markers

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“Beat the bunny” game place markers

“Beat the bunny” game place markers

“Beat the bunny” game place markers

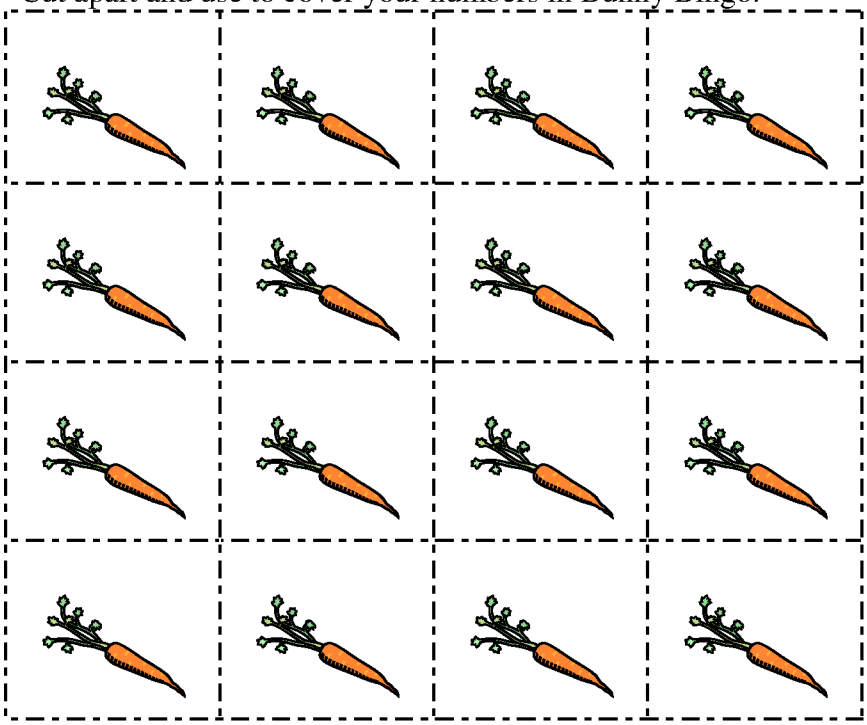
Name_____

Bunny Bingo

1. Use the numbers below to fill in the boxes on your BINGO card. You will not use all of the numbers.
2. The teacher will use the bunny flash cards to call out a multiplication fact.
3. If you have the product on your board, place a marker on the number.
4. Get 4 in a row, up, down, across, or diagonally, and say "Bunny Bingo!"
5. Have fun!

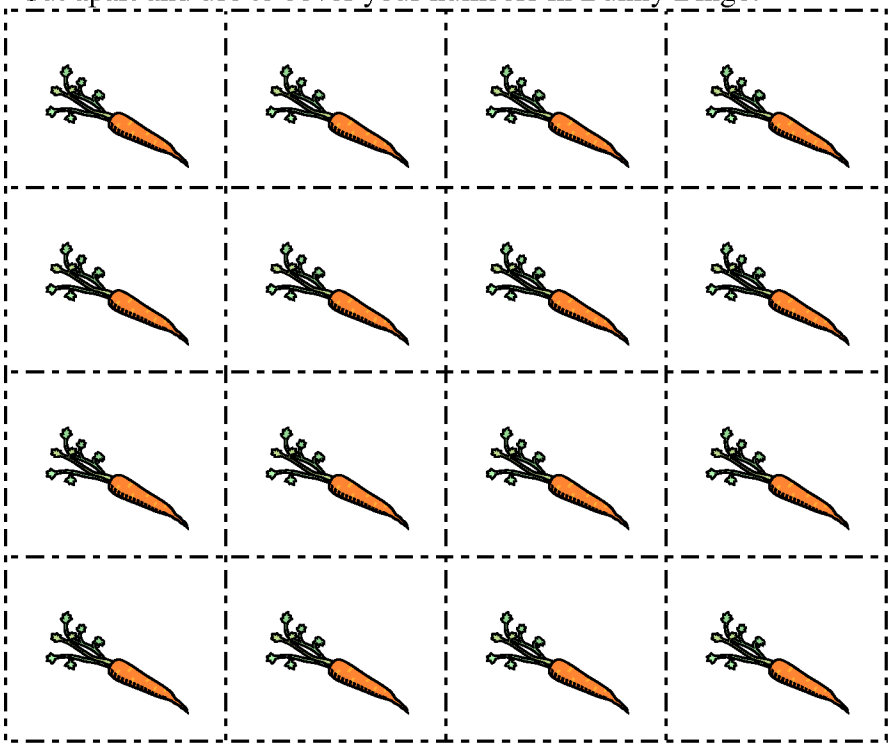
12	28	20	15	32	42	72
24	24	36	45	27	30	48
18	35	40	56	21	63	54

Cut apart and use to cover your numbers in Bunny Bingo.



Bunny Bingo Markers

Cut apart and use to cover your numbers in Bunny Bingo.



Bunny Bingo Markers

Dear Garden Engineer,

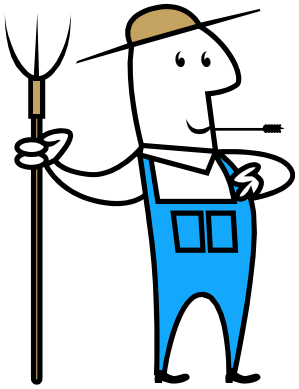
Thank you so much for helping me map out my garden. Now I know exactly where to find each kind of plant and I have the perfect number of each. I have never had such a neat and organized garden before. I am so excited and I love it!

I can't believe how important multiplication is! I never realized that knowing my multiplication facts was important to gardening. You have taught me so much!

I am going to keep practicing my facts so I can be as fast as you. Sometimes I still need to draw a picture to figure it out, I want to be able to know how many plants are in each plot just by quickly knowing how many rows there are.

I really appreciate all of your help. I will happily recommend your services to all of my farmer friends, so make sure you keep up with your math facts too! You may be very busy in the future.

Sincerely,
Farmer Magill



Name_____

Name_____

Oh no!

Farmer Magill is so thankful for your help, but he has one more little problem that he needs help with. Work with your partner to help solve Farmer Magill's problem.

On the side of the house, Farmer Magill is growing pumpkins. Unfortunately, he planted them long before he knew how helpful multiplication could be. The pumpkins are a mess. They are growing every which way and Farmer Magill cannot keep track of them. He needs your help to organize them. He has counted 48 pumpkins. How can he replant them so they are more organized?

Draw a picture of how the pumpkin patch should look.

What is the math fact that matches your picture?

Use words, numbers, and/or symbols to explain how you know.

_____

_____

_____

_____

_____

_____

_____

Name_____

Target Facts Summative Assessment

1. Farmer Magill needs to install an irrigation system to water all of his plants. He needs to install 8 rows of sprinklers with 3 in each row. How many sprinklers will Farmer Magill need to buy?

   _____ sprinklers
   Use words, numbers, and/or pictures to explain your answer.

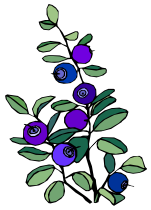
2. Farmer Magill will tend to his crops 5 days a week. If there are 4 weeks in the month, how many days will Farmer Magill spend taking care of his plants?

   _____ days
   Use words, numbers, and/or pictures to explain your answer.

3. Farmer Magill wants to plant 42 blueberry plants in 6 rows. How many plants will he need to put in each row?

_____ plants

Use words, numbers, and/or pictures to explain your answer.



You will have 2 minutes to complete the following facts.

3x4=	4x9=	3x9=
4x6=	5x8=	5x6=
3x6=	3x5=	6x8=
4x7=	4x8=	7x8=
3x8=	6x7=	3x7=
5x7=	8x9=	7x9=
4x5=	5x9=	6x9=

Name_____

Target Facts Summative Assessment- Answer Key

1. Farmer Magill needs to install an irrigation system to water all of his plants. He needs to install 8 rows of sprinklers with 3 in each row. How many sprinklers will Farmer Magill need to buy?

   24 sprinklers
   Use words, numbers, and/or pictures to explain your answer.

   (answers will vary)
   Students could write the multiplication fact, draw an array, or any reasonable explanation for how they solved the problem.

2. Farmer Magill will tend to his crops 5 days a week. If there are 4 weeks in the month, how many days will Farmer Magill spend taking care of his plants?

   20 days
   Use words, numbers, and/or pictures to explain your answer.

   (answers will vary)
   Students could write the multiplication fact, draw an array, or any reasonable explanation for how they solved the problem.

3. Farmer Magill wants to plant 42 blueberry plants in 6 rows. How many plants will he need to put in each row?

   7 plants

Use words, numbers, and/or pictures to explain your answer.

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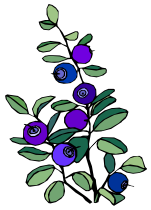

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